PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Means for Lubricating Toothed Gears

We, ALFRED BOOTH, of 8, Alresford Road, Claremont Estate, Pendleton, Salford, 6, in the County of Lancaster, a Subject of the King of Great Britain and Ireland, and WALLWORK GEARS LIMITED, of Union Bridge Iron Works Roger Street, Red Bank, Manchester, 4, in the County of Lancaster, a Company incorporated under the Laws of Great Britain, do hereby declare the nature of this invention to be as follows:—

This invention relates to means for lubricating toothed gears.

Hitherto, toothed gears have been lubricated by partial or complete immersion in a bath of lubricant with the purpose of covering the working faces with lubricant and in some cases also extracting from the gears the heat generated when the gears are running. However when the gears are running at substantial speeds, the centrifugal effect is such as to resist the flow of lubricant to the said working faces; and at high speeds, the centrifugal effect becomes so great as completely to prevent the said flow. Consequently there is between the working faces a metal-to-metal contact which causes abrasion and wear of the working faces and the generation of much heat.

The object of our invention is to provide a novel means for lubricating toothed gears whereby the possibility of metal-to-metal contact at high speeds and therefore of abrasion and wear of the working surfaces is reduced and there is also a reduction in the amount of heat created by the gears and a cushioning and pressure equalizing effect is obtained between the driving faces.

Means for lubricating toothed gears in accordance with our invention comprises lubricant passages in the gear leading outwardly and arranged to deliver lubricant from the interior of the gear outwardly into the tooth gap or gaps thereof, whereby centrifugal effect assists in the delivery of lubricant into the tooth gap or gaps.

The lubricant passages preferably have their outlet orifices arranged on the bottom or root of the tooth gap or gaps or on the driving face of the tooth or each tooth, there being at least one orifice in every tooth gap.

Where the outlet orifices are arranged in the bottom or root of the tooth gap or gaps, they are preferably positioned close to the working face of the tooth or each tooth and the passages are arranged to direct lubricant from the orifice direct on to the working face.

The inlet orifices of the passages are preferably in a feed passage or chamber provided centrally in the gear or shaft on which the gear is mounted and leading from one end of the shaft or gear at which place there is a continuous supply of lubricant.

The said supply of lubricant may be caused to flow to the lubricant passages by any suitable means.

One suitable means consists in a lubricant receptacle in which a head of lubricant can be maintained, the receptacle being arranged to permit the flow of lubricant from it to the lubricant passages.

Another suitable means consists of a lubricant pump which pumps lubricant to the lubricant passages.

The said pump is preferably a centrifugal pump, the impeller of which is provided on the said shaft or the gear.

In one construction, as applied by way of example to a three-start worm meshing with a worm wheel, we provide the worm with an axial passage extending from one extremity of one of the two cylindrical ends of the worm centrally along the worm up to a point at or beyond the worm teeth. Leading from the axial passage there are a plurality of lubricant passages which lead to each of the three tooth gaps of the worm. The lubricant passages are preferably straight so that they can be readily produced by drilling. The lubricant passages have their outlet orifices disposed at the bottom or root of the tooth spaces. Each lubricant passage is in a plane which is parallel with the face profile of the tooth to which its orifice is adjacent. The outlet orifices of some of the lubricant passages are adjacent to the one working face of each tooth whilst the outlet orifices

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of the remaining lubricant passages are adjacent to the other working face so that lubricant flowing through the lubricant passages flows directly on to the said faces at the root thereof and thereby coats the said faces with an uninterrupted and continuously maintained film or coat of lubricant. There are a plurality of outlet orifices for each tooth gap. For example there may be six orifices for each turn of each tooth gap, the six orifices being arranged alternately adjacent the two working faces of the tooth gap.

Lubricant is fed to the axial passage by any suitable means and flows from the axial passage into and along the lubricant passages radially or outwardly. The streams of lubricant flowing through the lubricant passages escape therefrom at the bottom or root of the tooth gaps, and due to the direction of the lubricant passages and the disposition of the outlet orifices of the lubricant passages, the streams flow continuously onto the working faces at the roots thereof and continuously outwardly to the crowns of the said surfaces, and in so doing produce and maintain on the said faces an unbroken and continuous film of lubricant which interposes itself between the working faces of the worm and the working faces of the worm wheel teeth and thereby prevents metal-to-metal contact of the said surfaces at all times during the running of the gears and also to some extent cushions and equalizes the pressure between the driving faces of the worm and the driven faces of the worm wheel or between the driving faces of the worm wheel and the driven faces of the worm. The streams of lubricant squirting from the outlet orifices which are situated in those parts of the tooth gaps which the teeth of the worm wheel do not engage or only partially engage, hit the teeth and root of the worm wheel before the teeth fully engage the tooth gaps of the worm and thereby cools and lubricates the said teeth before and after they engage the said tooth gaps. The lubricant flowing through the axial passages and the lubricant passages also cools the worm. The total result is that the lubricant reduces abrasion and wear and the temperature of the running gears and acts to cushion and equalize the driving pressure over different parts of the worm and worm wheel teeth.

Instead of the orifices of the lubricant passages being situated at the bottom or root of the tooth gaps, they may be disposed in the working faces of the teeth, in which cases the passages may be at an angle to the working faces.

It will be appreciated that a central passage and lubricant passages leading therefrom to the bottoms or roots of the tooth spaces or the roots of the working faces of the teeth of the worm wheel may also be provided to produce continuous lubricant films on the working faces of the worm wheel.

It will also be appreciated that a central passage and lubricant passages leading therefrom to the bottoms or roots of the tooth spaces or the roots of the working faces of the teeth of any other kind or type of toothed gear may be provided to produce continuous lubricant films on the working faces of the toothed gear for the hereinbefore specified purpose.

In all applications of our invention, the centrifugal effect caused by rotation of the gear, instead of resisting the flow of lubricant to the working faces as hitherto, produces or assists the said flow.

Any suitable means may be provided to ensure a continuous replenishment of the lubricant in the axial or central passage. One suitable means consists of a receptacle the interior of which is connected to the axial or central passage at the end of the gear, for example the worm, or at the end of the shaft on which the gear is mounted, for example the shaft on which the worm wheel is mounted. The top of the receptacle is higher than the outlet orifices of the lubricant passages and therefore if the receptacle is maintained full of lubricant, there is a head of lubricant which creates a flow of lubricant from the receptacle into the axial or central passage to replace the lubricant escaping from the lubricant passages.

Another suitable means of ensuring replenishment consists of a lubricant pump. In one convenient arrangement, as applied by way of example to a worm and worm wheel gear, the gears are provided in a casing which has a lubricant sump into which the lubricant falls from the gears. The sump is connected by a conduit to the interior of a cover mounted externally on the casing and closing one bearing of the worm. A reduced part of the end of the worm projects into the cover and the axial passage extends through the reduced part in the end of which is situated the inlet orifice of the said passage. A rotary impeller having pockets in its periphery is mounted on the reduced part and rotates in the cover. Lubricant flows by gravity through the conduit into the pockets successively and is raised by the pockets. The cover has in its upper part a curved port leading to the inlet orifice of the axial passage. As each pocket comes into register with the said port the lubricant therein is driven by centrifugal action into the said port and therefore a continuous flow of lubricant is created from the sump

into the axial passage. A packing disc secured to the cover and cooperating with annular ribs provided on the end of the impeller to form a lubricant seal prevents lubricant which has been driven into the said port from escaping into the said conduit.

Dated this 11th day of November, 1942.

For the Applicants,
F. BOSSHARDT,
Chartered Patent Agent.

COMPLETE SPECIFICATION

Improvements in or relating to Means for Lubricating Toothed Gears

We, ALFRED BOOTH, of 8, Alresford Road, Claremont Estate, Pendleton, Salford, 6, in the County of Lancaster, a Subject of the King of Great Britain and Northern Ireland, and WALLWORK GEARS LIMITED, of Union Bridge Iron Works, Roger Street, Red Bank, Manchester, 4, in the County of Lancaster, a Company incorporated under the Laws of Great Britain, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to that kind of means for lubricating toothed gears wherein lubricant flows into an axial passage in one of the gears, and from thence through radial passages leading from the said axial passage to the gear gaps.

The object of our invention is to provide a novel means of the said kind for lubricating a worm and worm wheel gear whereby the possibility of metal-to-metal contact at high speeds and therefore of abrasion and wear of the working surfaces is reduced and there is also a reduction in the amount of heat created by the gears and a cushioning and pressure equalizing effect is obtained between the driving faces.

Means of the hereinbefore specified kind for lubricating a worm and worm wheel gear in accordance with our invention comprises an axial lubricant passage in the worm and a plurality of lubricant passages distributed axially along the worm so as to lead lubricant from the first named passage to each thread at different points along its length, means being provided to force into the first named passage lubricant from a sump to which the lubricant is returned after leaving the gear.

In order that our invention may be fully understood and more readily carried into practice, we have caused to be appended hereunto drawings illustrating a constructional example thereof, wherein:—

Figure 1 is a fragmentary front view, partly in section of a worm gear.

Figure 2 is a cross-sectional view of the worm shown in Figure 1.

Referring to the drawings, in the construction shown therein, as applied by way of example to a three-start worm 1 meshing with a worm wheel 2, we provide the worm 1 with an axial passage 3 extending from one extremity of one of the two cylindrical ends of the worm 1 centrally along the worm 1 up to a point at or beyond the worm teeth. Leading from the axial passage 3 there are a plurality of lubricant passages 4 and a plurality of lubricant passages 5 which lead to each of the three tooth gaps of the worm. The lubricant passages 4 and 5 are preferably straight so that they can be readily producing by drilling. The lubricant passages 4 and 5 have their outlet orifices disposed at the bottom or root of the tooth spaces. Each lubricant passage 4 and 5 is in a plane which is parallel with the face profile of the tooth to which its orifice is adjacent. The outlet orifices of the lubricant passages 4 are adjacent to the one working face of each tooth whilst the outlet orifices of the lubricant passages 5 are adjacent to the other working face so that lubricant flowing through the lubricant passages flows directly and continuously on to the said faces at the root thereof. There are a plurality of outlet orifices for each tooth gap. For example there may be six orifices for each turn of each tooth gap, the six orifices being arranged alternately adjacent the two working faces of the tooth gap as shown in the drawings.

Lubricant is forced into the axial passage 3 by any suitable means and flows from the axial passage 3 into and along the lubricant passages 4 and 5 radially or outwardly. The streams of lubricant flowing through the lubricant passages 4 and 5 escape therefrom at the bottom or root of the tooth gaps, and due to the direction of the lubricant passages 4 and 5 and the disposition of the outlet orifices of the lubricant passages 4 and 5, the streams flow continuously onto the working faces of the worm 1 at the roots thereof and, when not obstructed by the engaging parts of the worm wheel 2 the said streams flow continuously outwardly to the

crowns of the said faces, and in so doing produce and maintain on the said faces an unbroken and continuous film of lubricant, subject to interruption or modification only by the action thereon of the opposed working faces of the worm and worm wheel teeth whilst transmitting the load. If the lubricant employed has the requisite properties, it is therefore able to prevent metal-to-metal contact of the said faces at all times during the running of the gears and also to some extent to cushion and distribute the pressure on a greater area of the driving faces. The streams of lubricant squirting from the outlet orifices which are situated in those parts of the tooth gaps which the teeth of the worm wheel 2 do not engage or only partially engage, hit the teeth and root of the worm wheel 2 before and after the teeth fully engage the tooth gaps of the worm 1 and thereby cool and lubricate the teeth of the worm wheel 2 before and after they engage the said tooth gaps. The lubricant flowing through the axial passage 3 and the lubricant passages 4 and 5 also cools the worm 1. The total result is that the lubricant reduces abrasion and wear and the temperature of the running gears and acts to cushion the driving pressure and distribute it over a greater area.

Instead of or in addition to the orifices of the lubricant passages being situated at the bottom or root of the tooth gaps, they may be disposed in the working faces of the teeth, in which case the passages may be at an angle to the working faces. The drawings show by way of example lubricant passages 6 having their outlet orifices on the working faces of the worm teeth, and lubricant passages 7 having their outlet orifices on the working faces of the worm teeth. For convenience of production, the lubricant passages 6 have their inlets in and receive their supply of lubricant from the lubricant passages 4 and 5, whilst the lubricant passages 7 have their inlets in and receive their supply of lubricant from the lubricant passages 6. Where the lubricant passages 4 and 5 are omitted, the lubricant passages 6 extend directly to and have their inlet orifices in the central lubricant passage 3.

One suitable means for forcing lubricant into the axial passage 3 consists of a geared pump 8 mounted in the sump of the casing 9 in which the worm 1 and worm wheel are journalled and enclosed. The pump 8 is driven from the worm 1 by means of a sprocket wheel 10 mounted on the worm 1 to rotate therewith and a sprocket wheel 11 mounted on the driving shaft 12 of the pump 8 to rotate therewith, the sprocket wheels 10 and 11 being coupled together by an endless driving chain 13. The pump 8 is immersed in lubricant which fills the sump to the level 14 and has its outlet connected by a pipe 15 to a nozzle 16 which has its extremity situated in a chamber 17 provided in the worm 1 and leading to the lubricant passage 3. A packing gland 18 or other suitable oil seal is provided between the stationary nozzle 16 and the rotary worm 1. Lubricant is drawn from the sump by the pump 8 and forced thereby continuously through the pipe 15, nozzle 16, chamber 17, passage 3 and passages 4, 5, 6 and 7, and after performing its lubricating function returns again to the sump by falling thereinto.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. Means of the hereinbefore specified kind for lubricating a worm and worm wheel gear, comprising an axial lubricant passage in the worm and a plurality of lubricant passages distributed axially along the worm so as to lead lubricant from the first named passage to each thread at different points along its length, means being provided to force into the first named passage lubricant from a sump to which the lubricant is returned after leaving the gear.

2. Means according to claim 1, wherein lubricant is forced into the first named passage by means of a pump driven by the gear and arranged in a sump provided in a casing in which the gear is journalled.

3. Means for lubricating a worm and worm wheel gear, substantially as hereinbefore described and shown in the accompanying drawings.

Dated this 19th day of October, 1943.

For the Applicants,
F. BOSSHARDT,
Chartered Patent Agent,
31, Regent House, Cannon Street,
Manchester, 4.

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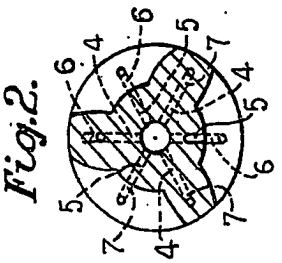

Fig. 2.

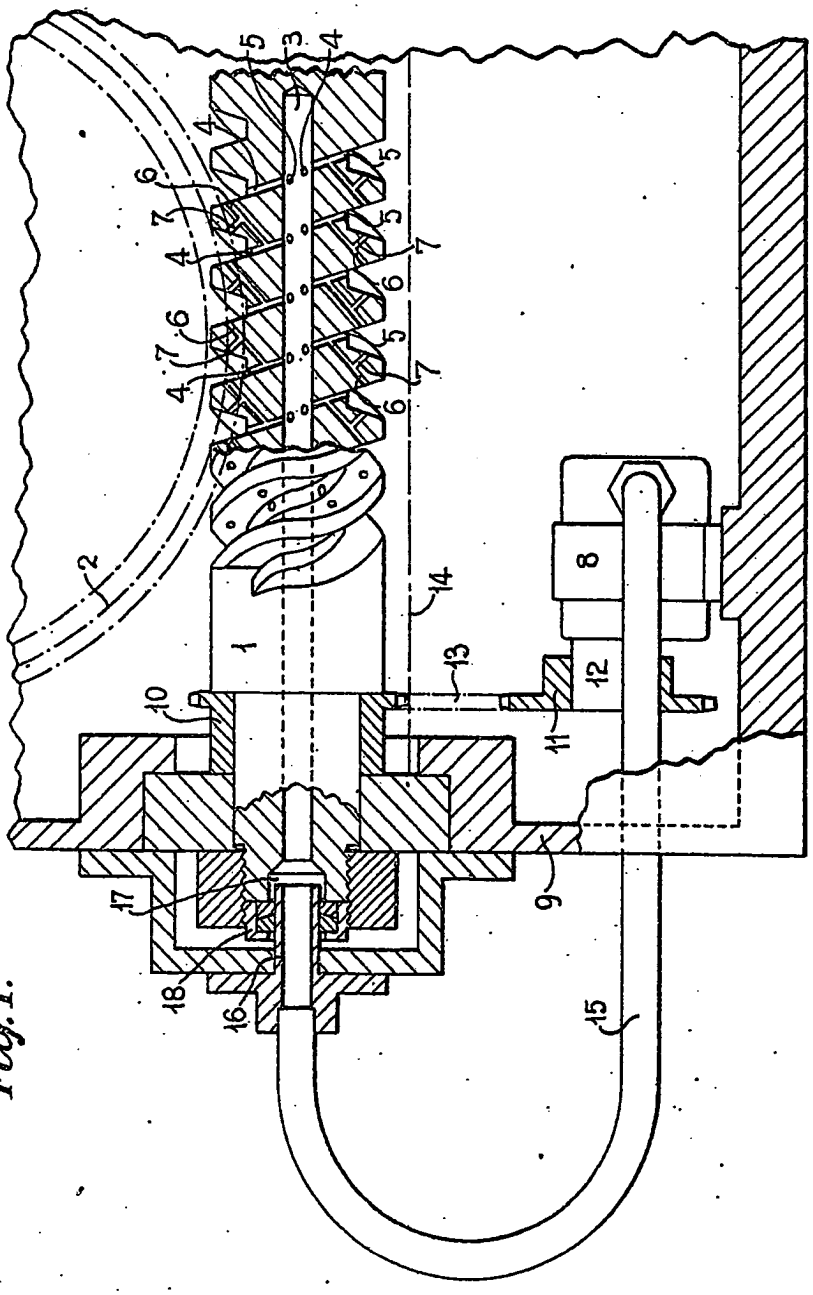

Fig. 1.

Malby & Sons, Photo-Litho.